

Instituto Politécnico Nacional

Centro de Investigación en Computación



robótica y mecatrónica

Research Projects and Masters Thesis Proposals 2022-B

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Senior Member IEEE



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LA TÉCNICA AL SERVICIO DE LA PATRIA



A little about me

- ❑ Ingeniero Mecánico Electricista (UNAM), 1987-1991
- ❑ Maestro en Ingeniería Eléctrica (UNAM – Mención Honorífica), 1997-1999
- ❑ PhD por la Universidad de Sheffield, UK, en el Departamento de “Automatic Control and Systems Engineering”, 1999-2003



A little about me

- ❑ Investigador Asociado en la Universidad de Bristol, Inglaterra, en los Departamentos de “Aerospace Engineering” y “Computer Science”, 2003-2010



A little about me

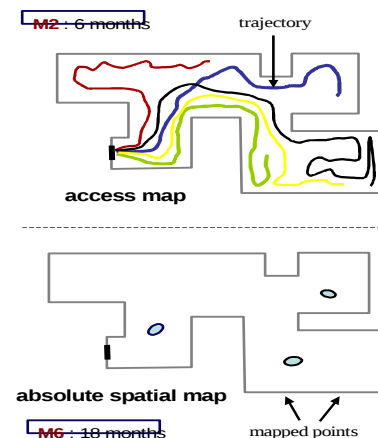
- ❑ Investigador Asociado en el Instituto Nacional de Astrofísica Óptica y Electrónica (INAOE), Departamento de Electrónica, 2010-2011
- ❑ PTC Universidad Politécnica de Guanajuato, 2011
- ❑ Director General de Innovación y Desarrollo (SEGOB), 2011-2013
- ❑ Profesor Investigador, CIC- IPN, desde 2013



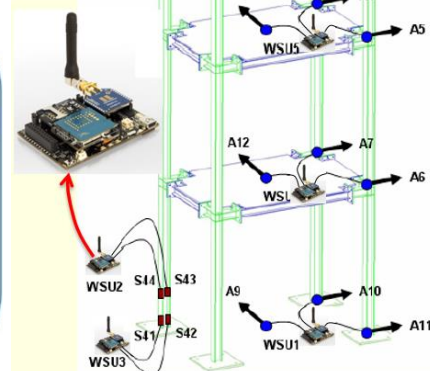
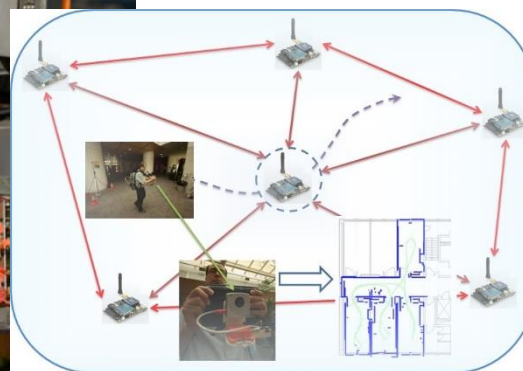
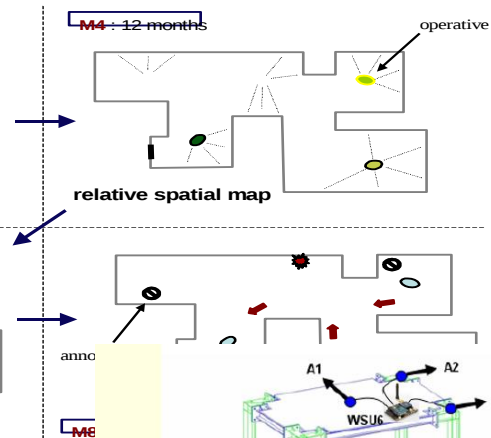
What I have done



ViewNet Demonstration



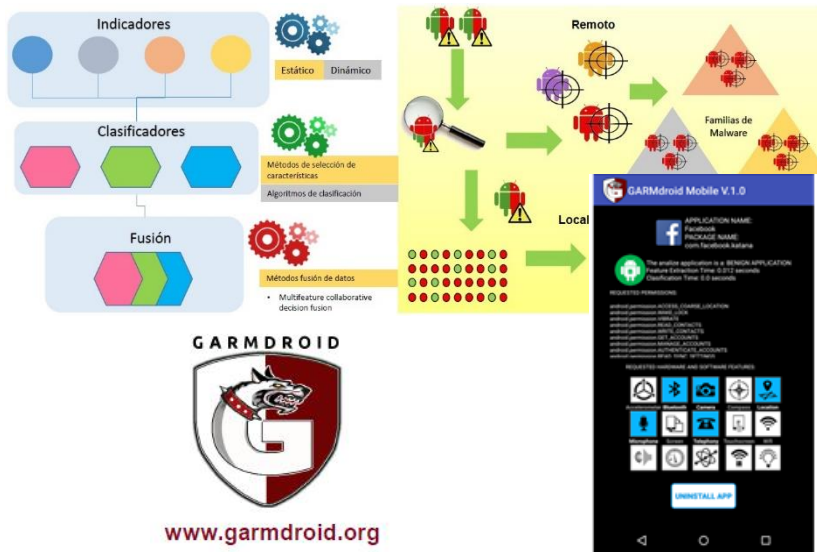
Search – Map – Annotate → Incident Map





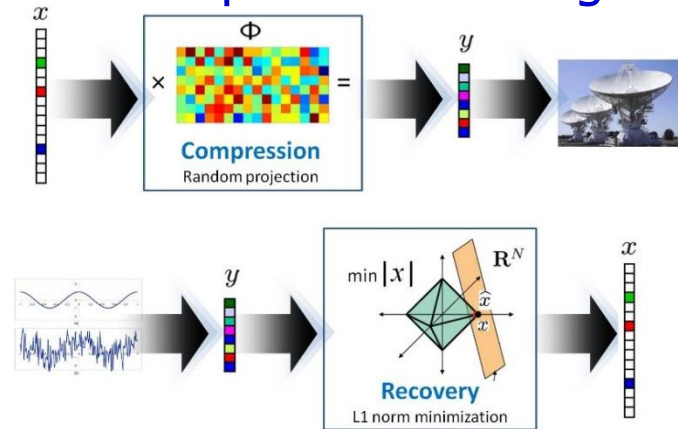
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Mobile Cyber Security



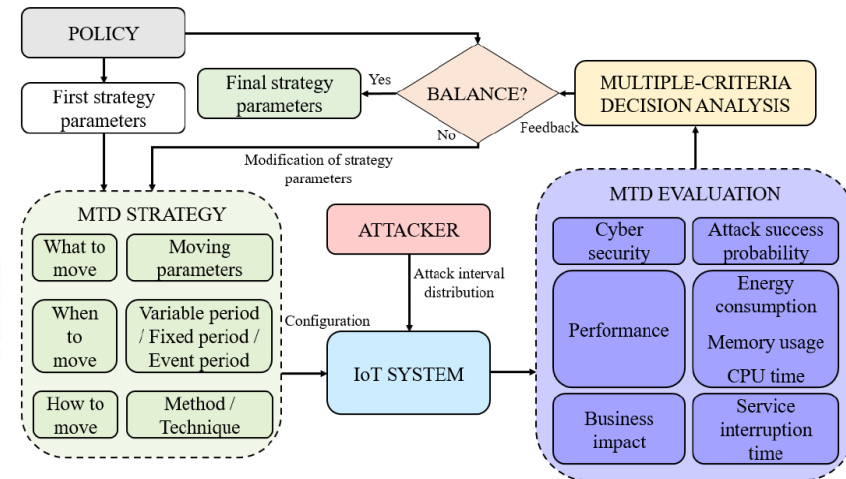
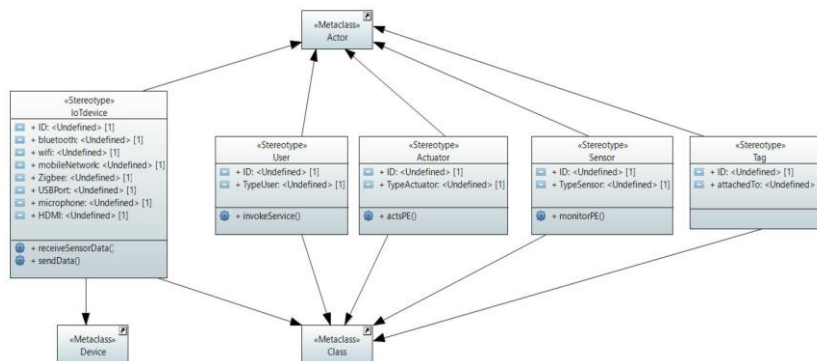
What I have done

Compressive sensing



A Moving Target Defense Strategy for Internet of Things Cybersecurity

IoTsecM: A UML/SysML Extension for Internet of Things Security Modeling



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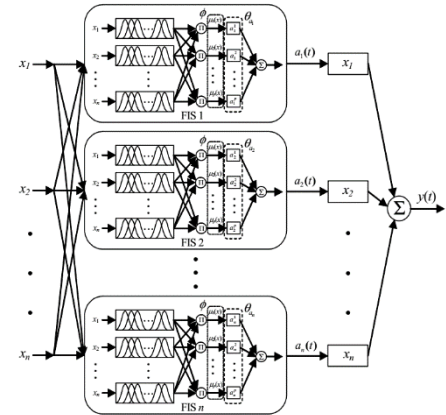
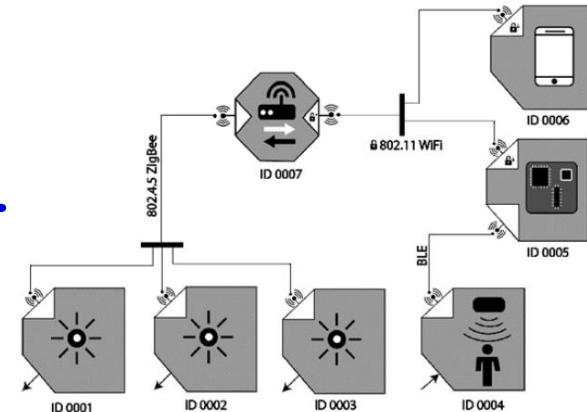
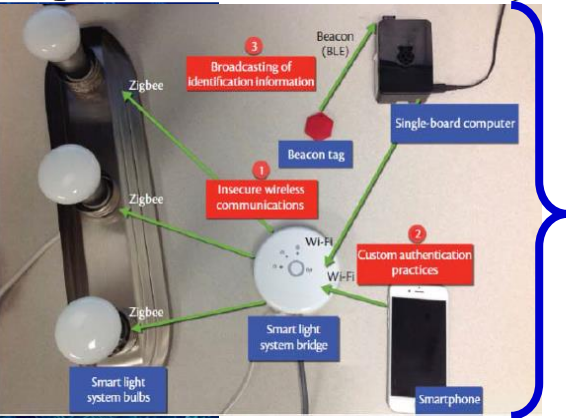


Mercado-Velázquez, A. A., Escamilla-Ambrosio, P. J., & Ortiz-Rodríguez, F. (2021). A Moving Target Defense Strategy for Internet of Things Cybersecurity. *IEEE Access*, 9, 118406-118418.
Escamilla-Ambrosio, P. J., Robles-Ramírez, D. A., Tryfonas, T., Rodríguez-Mota, A., Gallegos-García, G., & Salinas-Rosales, M. (2021). IoTsecM: A UML/SysML Extension for Internet of Things Security Modeling. *IEEE Access*, 9, 154112-154135.

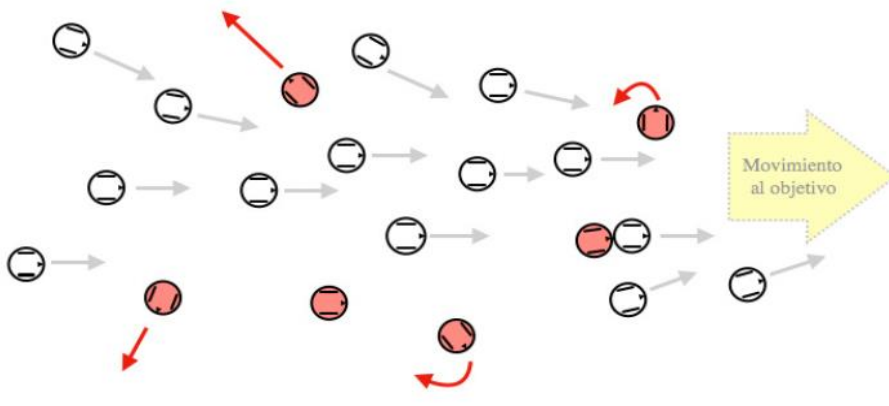
What I have done

Towards a Visual Grammar for IoT Systems Representation and their Cybersecurity Requirements

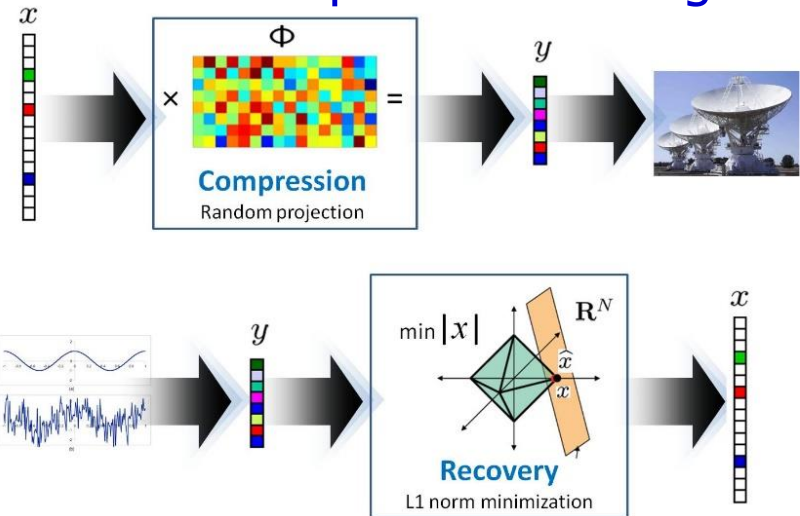
Fuzzy and Neuro-Fuzzy Systems



A Bio-Inspired Cybersecurity Scheme to Protect a Swarm of Robots



Compressive sensing

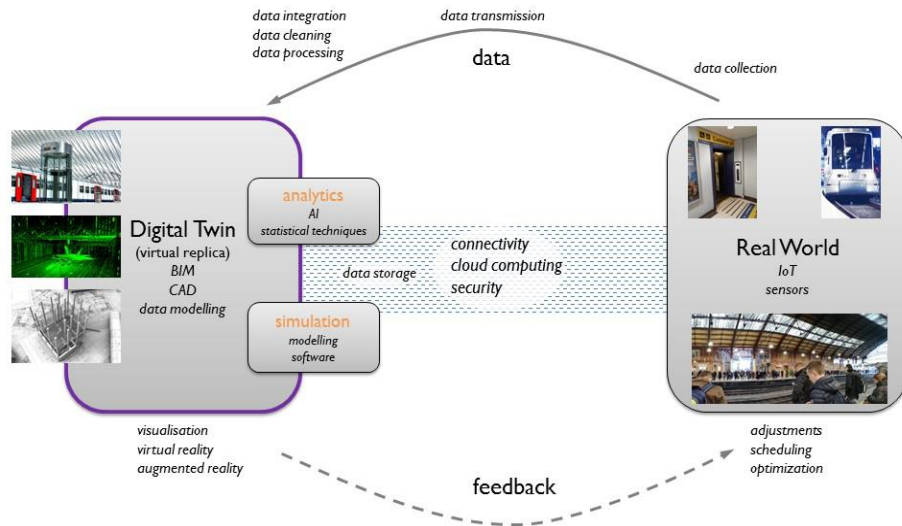


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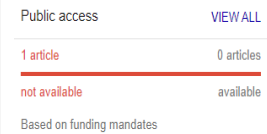
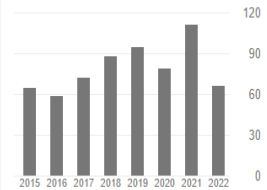
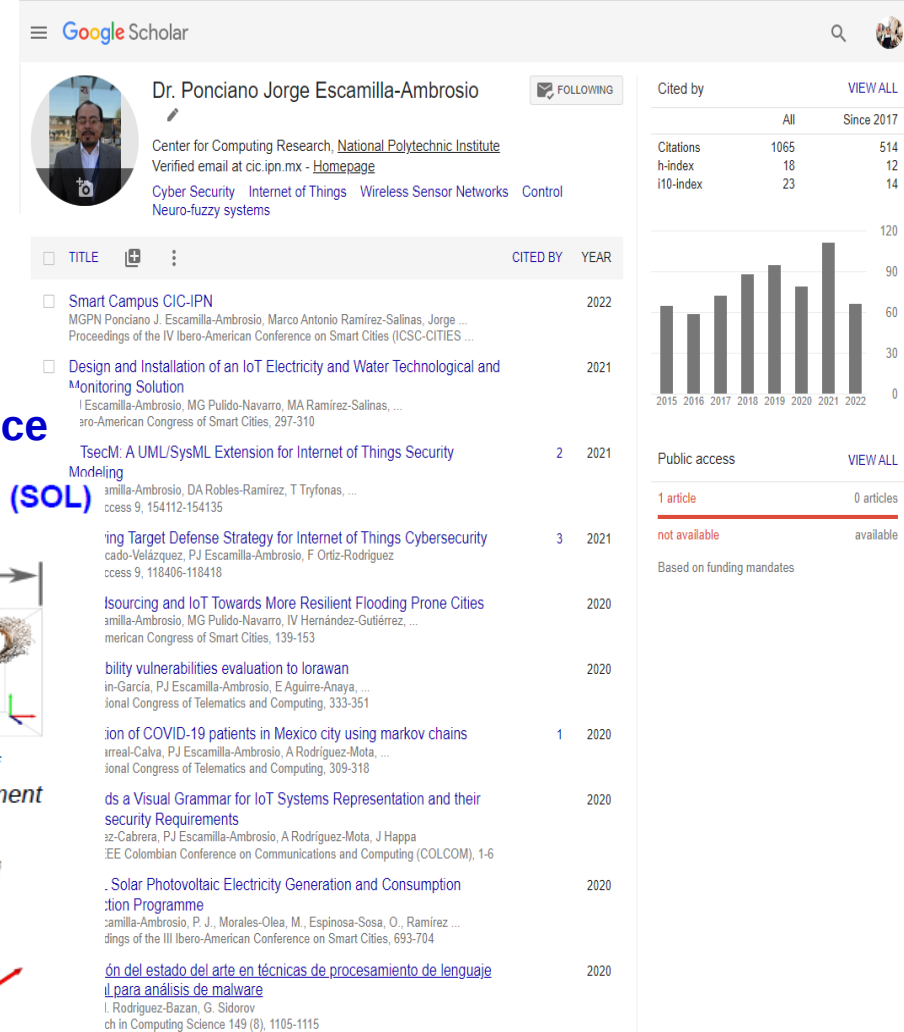
Gómez-Cabrera, A., Escamilla-Ambrosio, P. J., Rodríguez-Mota, A., & Happa, J. (2020, August). Towards a Visual Grammar for IoT Systems Representation and their Cybersecurity Requirements. In *2020 IEEE Colombian Conference on Communications and Computing (COLCOM)* (pp. 1-6). IEEE.
Hernández-Herrera, A., Espino, E. R., & Escamilla Ambrosio, P. J. (2018, October). A bio-inspired cybersecurity scheme to protect a swarm of robots. In *Mexican International Conference on Artificial Intelligence* (pp. 318-331). Springer, Cham.

Digital Twin for SHM

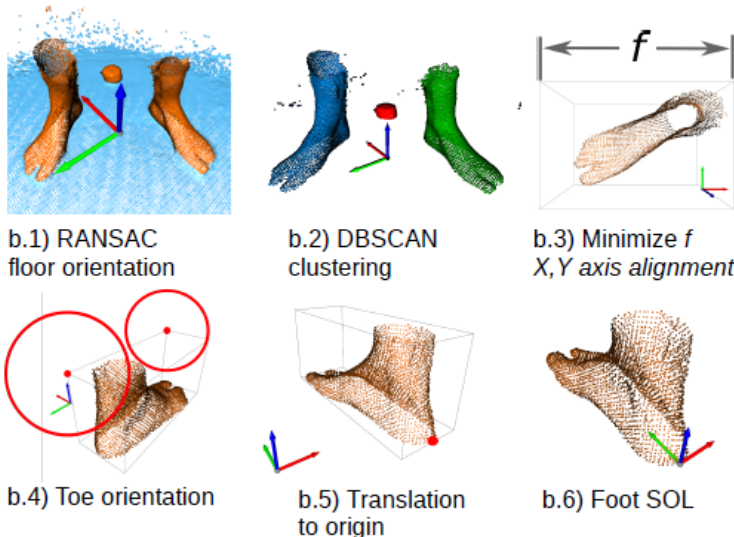


What I have done

https://scholar.google.com/citations?hl=en&user=6VwhgpUAAAAJ&view_op=list_works&sortby=pubdate



Foot Segmentation, Orientation and Localization (SOL)



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Project 1 Resilient Internet of Things (18 months)



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Resiliency Property: A system that *“remains safe and secure in the advent of faults and threats that could be even unpredictable at design time or could emerge during runtime.”* Laprie [1]

Resilient system is one which is dependable and secure: “The **dependability** property of a system is defined to be the combination of the following attributes: **availability** (readiness for correct service), **reliability** (continuity of correct service), **safety** (absence of catastrophic consequences), **integrity** (absence of improper system alterations), **maintainability** (ability to undergo modifications and repairs). **Security** includes **availability, integrity, and confidentiality** (the absence of unauthorized disclosure of information).” Ratasich et al. [2]



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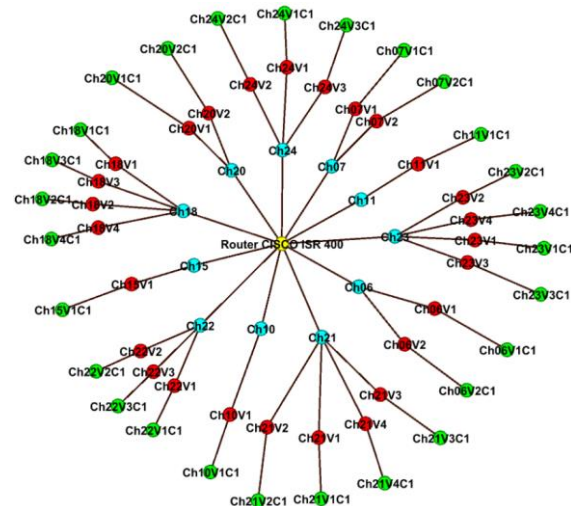
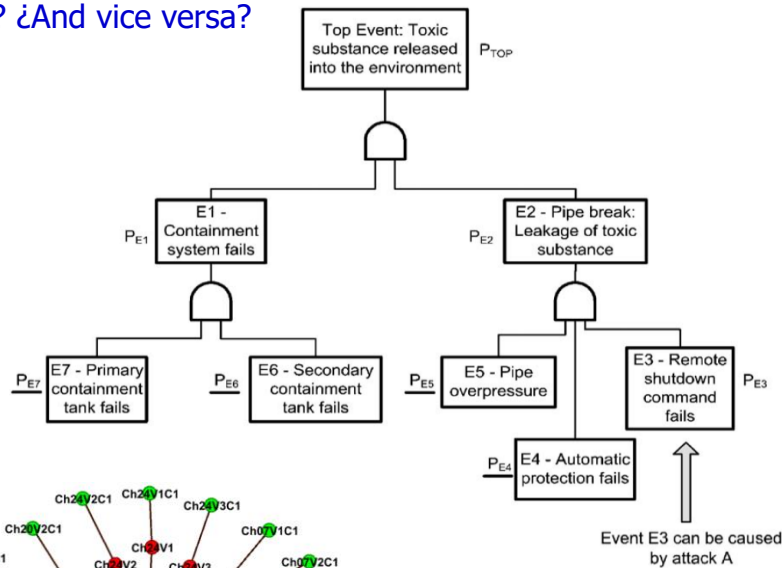
[1] J.-C. Laprie, “From dependability to resilience,” in Proc. 38th Annu. IEEE/IFIP Int. Conf. Dependable Syst. Netw. (DSN), Jun. 2008, pp. G8–G9.

[2] Ratasich, D., Khalid, F., Geissler, F., Grosu, R., Shafique, M., & Bartocci, E. (2019). A roadmap toward the resilient internet of things for cyber-physical systems. IEEE Access, 7, 13260-13283.

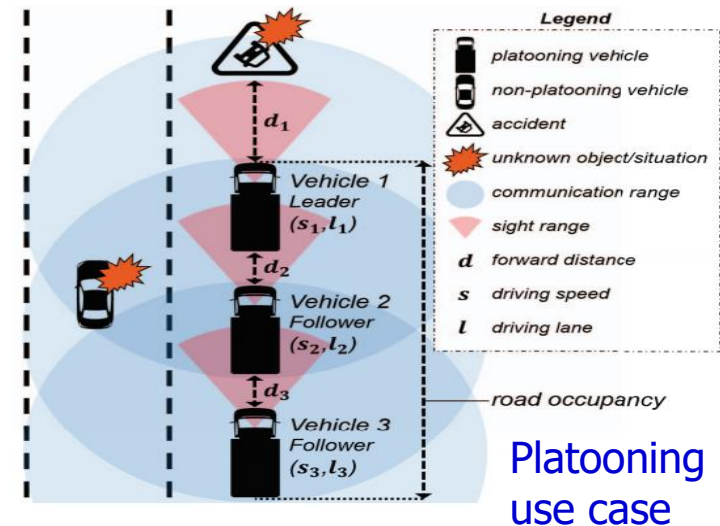
Thesis 1: Digital twin for resiliency in a swarm of robots

- ¿Is not an attack, it is a fault?
- ¿it is not a fault, it is an attack?
- ¿Is an attack tree an input to a fault tree? ¿And vice versa?

Fault Attack Tree



Vulnerabilities and countermeasures graph

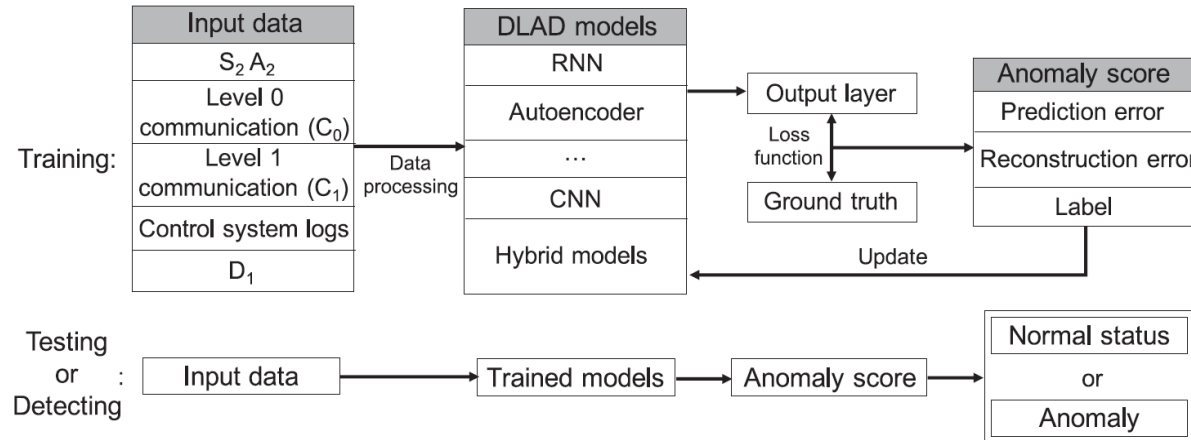


Platooning use case

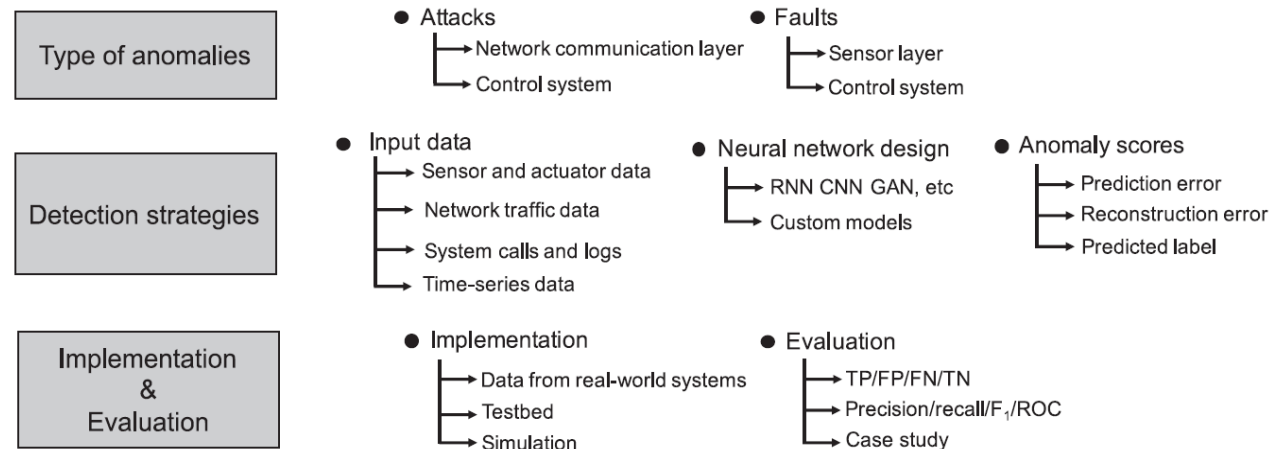


Thesis 2: Deep learning-based techniques to detect, analyze, and defend cyber-physical intrusion in IoT systems

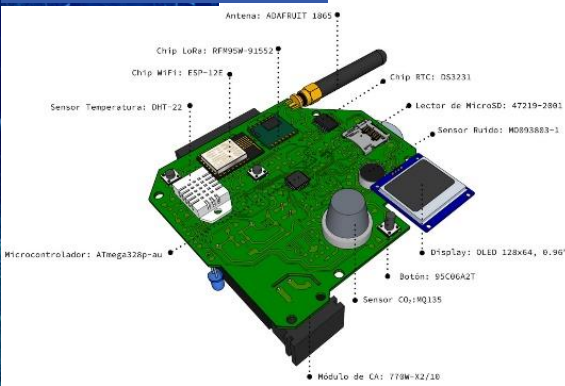
Deep Learning-based Anomaly Detection in Cyber-physical Systems



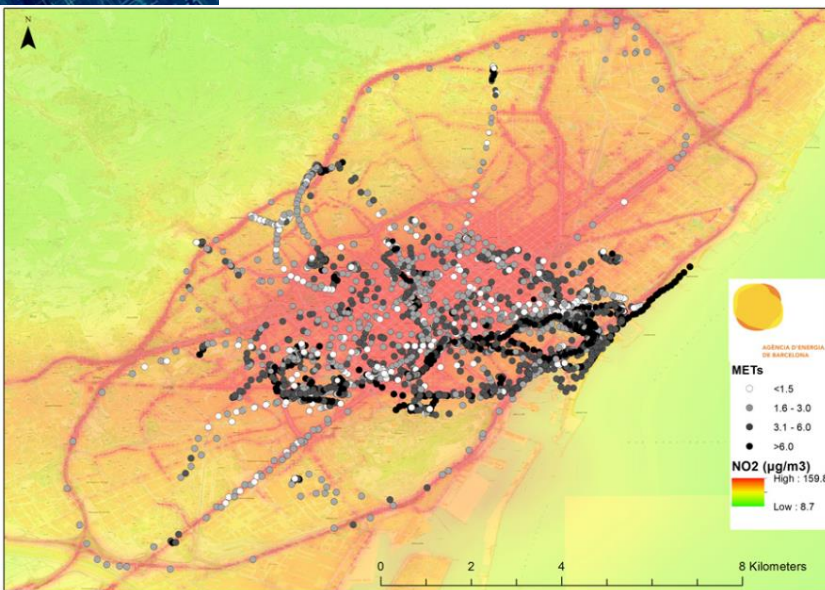
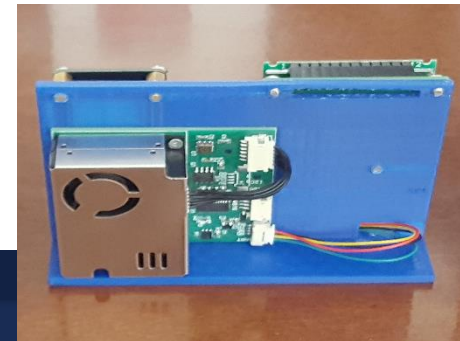
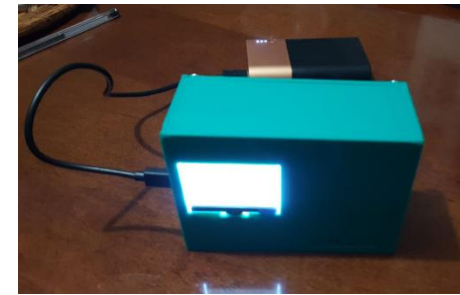
Taxonomy of deep learning-based anomaly detection methods



Project 2: Internet of Things and Crowdsensing for Pollution Monitoring and its Effects on Health

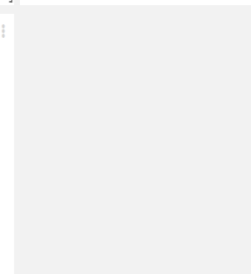
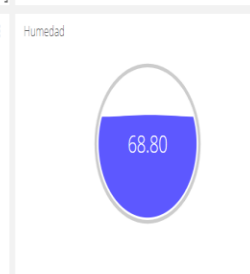
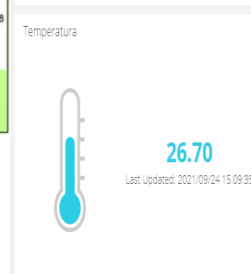
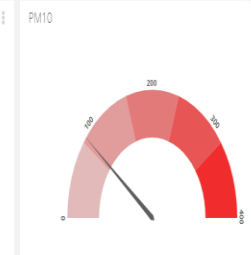
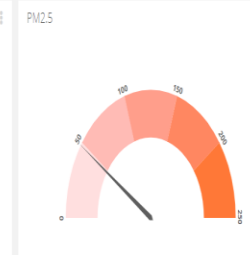
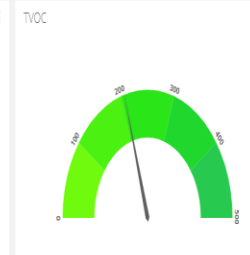


The Smart E-bike Monitoring System (SEMS) to collect real-time usage & sensor data



ubidots

tinker_home1



Laboratorio de estudios fotovoltaicos a pequeña escala

Especificaciones

Existen paneles ya instalados, y paneles que estarán destinados únicamente a pruebas y toma de datos en condiciones particulares de soiling, obstrucciones y etc.
La instalación destinada a este fin como laboratorio de pruebas tiene las sig. Características:

Modelo del panel: CS3U-365P Canadian Solar
Cantidad: 9
Potencia: 365.00 watts
Producción del sistema: 422.23 kWh/mes
Tamaño del sistema: 3.24 kW
Área aprox.: 22.50 m²
Modelo de inversor: YC600
Marca: APSsystem **Cantidad:** 9



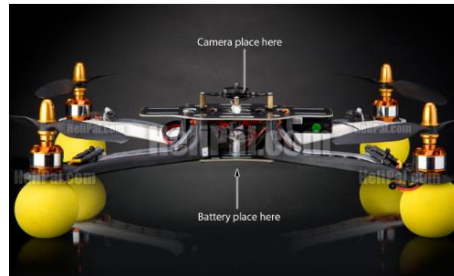
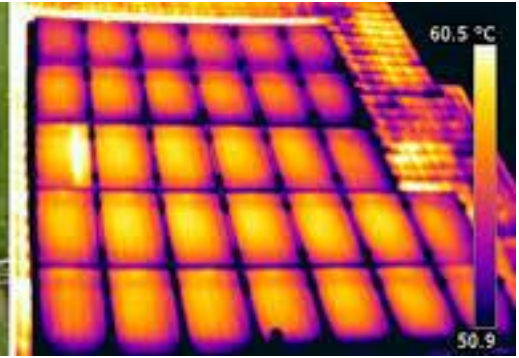
Herramientas adicionales

Continuación

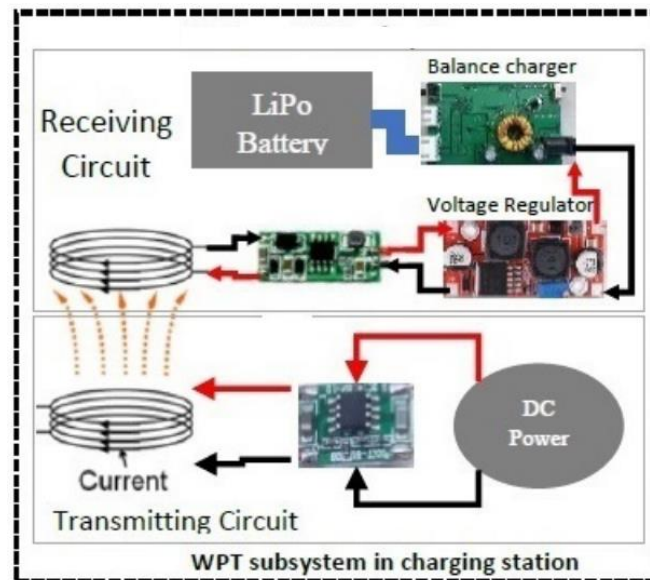
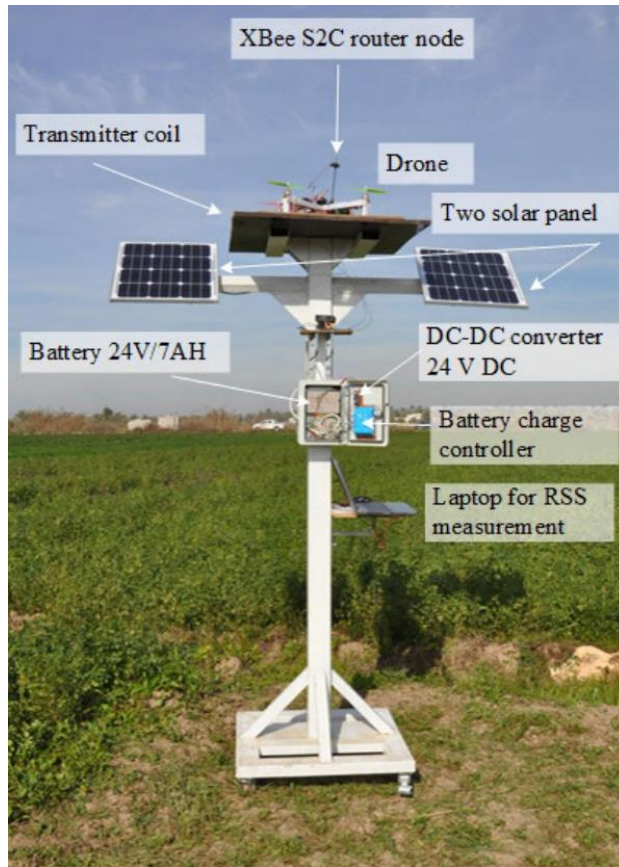
- **FLIR VUE Pro - 336, 13mm, 9Hz, NTSC**, Cámara térmica para uso profesional, adaptable a dron.
- **Quadrotor/Dron Inspire1 mod T600**, control remoto a más de 5km sin obstrucciones, cámara de 12Mp efectivos.
- **I-V500w, Compatible con Htanalysis**, Trazadora de curvas I-V 1500V.
- **SOLAR02**, unidad remota con sensor de irradiancia, compatible con I-V500w
- **PT300N Temperature**, Sensor de temperatura ambiente y temperatura de celdas, compatible con I-V500w



Thesis 5: Quadcopter for Solar Panels Cleaning / Inspection



Thesis 6: Solar charging station for quadcopters



Wireless
Charging
System



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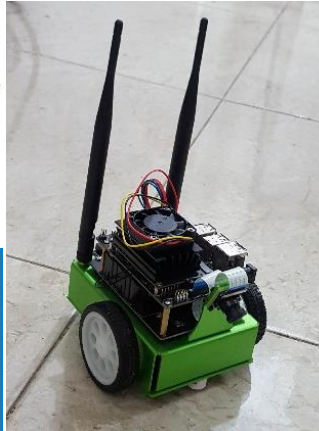
Jawad, A. M., Jawad, H. M., Nordin, R., Gharghan, S. K., Abdullah, N. F., & Abu-Alshaer, M. J. (2019). Wireless power transfer with magnetic resonator coupling and sleep/active strategy for a drone charging station in smart agriculture. *IEEE Access*, 7, 139839-139851.

Resources

NVIDIA Jetson Nano



JetBot



IoT Development kits



Zolertia wireless sensor network platform



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Links



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OF TWENTE.



THE UNIVERSITY
of EDINBURGH



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More Information

For more information visit:

- <http://www.cic.ipn.mx/index.php/es/acerca-de-rym>
- <http://www.cic.ipn.mx/~pescamilla/>

Or contact:

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